How Time Preferences Differ: Evidence from 53 Countries

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Abstract

We present results from the first large-scale international survey on time preference, conducted in 53 countries. All countries exhibit hyperbolic discounting patterns, i.e., the immediate future is discounted more than far future. We also observe higher heterogeneity for shorter time horizons, consistent with the pattern reviewed by Frederick, Loewenstein, and O'Donoghue (2002). Cultural factors as captured by the Hofstede cultural dimensions (Hofstede, 1991) contribute significantly to the variation of time discounting, even after controlling for economic factors, such as GDP, inflation rate and growth rate. In particular, higher levels of Uncertainty Avoidance are associated with stronger hyperbolic discounting, whereas higher degrees of Individualism and Long Term Orientation predict stronger tendency to wait for larger payoffs. We also find the waiting tendency is correlated with innovation, environmental protection, crediting rating, and body mass index at country level after controlling for county wealth. These results help us to enhance the understanding of differences across financial markets and economic behavior worldwide.

Keywords: Time preferences; Intertemporal decision; Endogenous preference; Cross-cultural comparison.

JEL classification: D90, F40

1 Introduction

Time preference is one of the most fundamental concepts in economics. It has been widely applied in asset pricing, project evaluation, and decisions on investment and saving, among many others. Our survey is a first attempt to collect large-scale empirical data on country-level variations of time preferences for monetary payoffs. It is to our knowledge the largest international survey of this kind.

Many factors have been proposed in the literature that could influence subjective time discounting, such as income, development, culture, and so forth (Becker & Mulligan, 1997). Given that many of these economic and cultural factors naturally vary among different countries, it would be very interesting to test some of the influencing factors in a cross-country sample. In this article, we elicit time preferences in a large sample across 53 countries and examine the impacts of culture on time preference.

Studies on cross-cultural differences in temporal discounting are rare. Most of them involved only two or three countries, e.g., Canadian undergraduates and foreign undergraduates of Chinese descents (Tan & Johnson, 1996), American, Chinese and Japanese graduate students living in the U.S. (Du, Green, & Myerson, 2002), and Israeli Arabs and Israeli Jews (Mahajna, Benzion, Bogaire, & Shavit, 2008).

One problem associated with small samples are confounding factors. Studies on a limited number of cultural groups have inherent difficulties in distinguishing the impacts of socio-economic and cultural factors. For example, the United States and China are different in many dimensions, including economic situation, political system, and cultural roots. It is hard to deduce what causes the observed differences in time preference. To study more systematically the impacts of country-level factors, it is helpful to include

other countries. For example, including countries like Japan or South Korea, which have similar cultural roots as China, but a similar economic development and political system as the U.S., helps to disentangle these factors. Including countries in Eastern Europe with different cultural roots, but similar modern political experiences as China, is another example how a larger international sample can provide deeper insights.

The large number of countries included in our survey allows us to link the measured time preference with the economic and cultural backgrounds of these countries. We elicit time preferences and time discounting for different time horizons (one month, one year, and ten years). Our main findings are:

- The discount rate for one year is much higher than the discount rate for ten years: hyperbolic discounting is a global phenomenon.

- Time discounting for relatively short time horizons exhibits much higher heterogeneity than for longer time horizons, consistent with the pattern noticed by Frederick et al. (2002).

- Cultural factors as captured by the Hofstede cultural dimensions (Hofstede, 1991) contribute significantly to the variation of time discounting. In particular, high levels of Uncertainty Avoidance are associated with stronger hyperbolic discounting, whereas higher degree of Individualism and Long Term Orientation predict a stronger tendency to wait for larger payoffs.

- We also find that countries with a higher pace of time measured from field studies (e.g., more punctuality and higher walking speed, as defined by Levine (1997)) are more likely to wait for higher returns, which provides an external validity for the measurements in our survey.

The collected data on time preferences and time discounting has already led to many interesting applications, particularly in behavioral finance, such as applications to the equity risk premium puzzle (Rieger, Wang, & Hens, 2013), dividend payoff policies (Breuer, Hens, Salzmann, & Wang, 2015), and household debt maturity (Breuer, Rieger, & Soypak, 2014). Institutions dealing with economic policy issues also find our survey highly valuable. For example, Marcheggiano and Miles (2013) from the Bank of England used our data to explain international differences in the effectiveness of fiscal policy.

The rest of this article is organized as follows: In the second section, we review the literature on culture and time preferences. In the third section, we present the survey methodology. In the fourth section, we summarize the key results. In the final section, we discuss possible future research directions for which this survey data could be used.

2 Relationship between culture and time preferences

Economists traditionally assume preferences are given and there is no role of culture. As Fehr and Hoff (2011) noted, such views become obsolete with the growing literature showing that preferences can be endogenous and can be shaped by societal and cultural influence (Bowles, 1998; Henrich, 2000; Stern, Dethier, & Rogers, 2005; Eugster, Lalive, Steinhauer, & Zweimüller, 2011; Hoff, Kshetramade, & Fehr, 2011).

Perception of time is a part of culture. Culture is typically defined as something stable over time that distinguishes different groups. Although an abstract and vague concept to most economists, sociologists and psychologists have studied in depth the impacts of culture on various aspects, such

as personality, cognition, social and economic development. One of the most influential measurements for culture has been developed by the Dutch sociologist Geert Hofstede during his long-term research on cross-national organizational culture. Five persistent cultural dimensions have been found across different nations and different time periods (Hofstede, 1991, 2001). Here we discuss three important cultural dimensions related to time preferences, namely Individualism, Uncertainty avoidance and Long Term Orientation. Section 3.2 provides more details on the measurement.

Individualism/collectivism is one of the most crucial cultural dimensions and has been extensively studied. A high score of Individualism implies that individuals are loosely connected to the society, and are expected to take care of themselves. In comparison, in a society with collectivistic culture, people can be protected by some strong cohesive groups throughout lifetime as a reward to their unshakeable loyalty. The relationship between individualism and time preference, however, is not clear. On the one hand, the social connection in a collectivistic culture may provide its citizens a "cushion" or safety net for potential losses (Hsee & Weber, 1999; Li & Fang, 2004; Weber & Hsee, 1998), with which people can afford to wait longer and to be more patient. On the other hand, in an individualistic society, people are expected to be more independent and to plan their lives by themselves. Triandis (1971) notes that the "modern man" in a more individualistic culture is more "concerned with time, planning, willing to defer gratification," whereas the "traditional man" in a more collectivistic culture "considers planning a waste of time, and does not defer gratification."(p.8.) Therefore, it is also possible that people in an individualistic culture learn to plan for the future and hence are more patient. To test the impacts of a collectivistic culture, Mahajna et al. (2008) compared the subjective discount rates and risk preferences for

Israeli Jews and Arabs with bank customers as participants. Their findings show that Israeli Arabs, who are supposedly from a more collectivistic society, have higher subjective discount rates, corresponding to less patience towards monetary incentives. However, as discussed in the introduction, it is difficult to disentangle confounding factors with only two cultural groups. Therefore, with a large sample of countries in our study, we can test more systematically the relationship between individualism and time preferences, after controlling other cultural and economic factors.

Uncertainty Avoidance is another cultural dimension relevant to time preferences. A society with a higher Uncertainty Avoidance score tends to be less tolerant to uncertain situations. Since future is less predictable than the present, we expect people from cultures with a higher uncertainty avoidance tendency to prefer immediate rewards rather than future rewards. To our best knowledge, no empirical studies have investigated this relationship yet.

The third cultural dimension we study is labeled as "Long Term Orientation." Hofstede (1991) finds that the Long Term Orientation Score is typically high in East Asia, especially in Confucian cultures. It implies that people in such cultures tend to put higher value on the future, and they are more likely to be patient. Moreover, the concept of "rebirth" in the dominant religions (e.g., Buddhism and Hinduism) in Southeast Asia reflects the belief that the current life is only a small time interval of one's entire existence. Benjamin, Choi, and Strickland (2010) find that priming with Asian identities makes Asian-American subjects more patient. Chen, Ng, and Rao (2005) find a similar pattern with bicultural Singaporean participants: participants primed with the U.S. culture tend to value immediate consumption more than Singaporean-primed participants do. However, no previous studies have directly measured both the Long-term Orientation cultural dimension

and time preferences within the same subject pool as our study does.

3 Methodology

3.1 Measuring time preference

This survey was part of the larger study INTRA (International Test of Risk Attitudes), conducted by the University of Zurich. The survey contained three questions on time preferences. The first question was a binary choice question taken from Frederick (2005), which we refer to as the "wait-or-not" question in the rest of the article. The question was presented as follows:

Which offer would you prefer?

A. a payment of $3400 this month

B. a payment of $3800 next month

To measure the implicit discount rate more directly, in the next two questions, we asked participants to give the amount of a delayed payment which makes them indifferent with an immediate payment. We refer to these two questions as the "one-year matching question" and the "ten-year matching question," respectively. These two questions are[1]:

[1]The choice task was chosen from the the first question from Frederick (2005), whereas the matching task is adapted from two other questions from Frederick (2005). While at first glance, these numbers seem to be of different orders of magnitude, they are not when considering the typical answers given by subjects: the median answer for question 3, e.g., was $1400 and 25% of the subjects even chose a value of $10,000 or larger. This is of the same order of magnitude as the amounts in question 1. A starting amount similar to the

Please consider the following alternatives

A. a payment of \$100 now

B. a payment of \$ X in one year from now

X has to be at least \$ __, such that B is as attractive as A.

Please consider the following alternatives

A. a payment of \$100 now

B. a payment of \$ X in 10 years from now

X has to be at least \$ __, such that B is as attractive as A.

The amount of monetary payoffs in the questions were adjusted according to each country's Purchasing Power Parity (PPP) and the monthly income/expenses of the local students.[2]

3.2 Measuring cultural dimensions

In the second part of our questionnaire, we used the Values Survey Module (VSM94) developed by Hofstede and his colleagues to measure the cultural dimensions (Hofstede, 2001). In particular, we use the results for the following three cultural dimensions that are relevant to time discounting:

- Individualism (IDV): IDV measures the degree to which the society reinforces individual or collective achievement, and the extent to which

one-month choice question would therefore have led to much larger amounts.

[2]The conversion ratio of country i vs. the U.S. is obtained by $X_{i,US}P_i/P_{US}$, where $X_{i,US}$ is the exchange rate of country i and the U.S., P_i and P_{US} are the GDP(PPP) per capita of country i and the U.S. for the year that the survey was conducted. Additionally, whenever possible, we collected information from difference sources to estimate the monthly income/expenses of local students (e.g., hourly wage for a student job, typical food prices in cafeteria, etc.) to double check wether the conversion ratios can be applied to the university students and in some cases adjusted accordingly.

people are expected to stand up as an individual as compared to loyal affiliation to a life-long in-group (e.g., extended family, friends, etc.). The opposite of individualism is collectivism. For example, the U.S. has an individualistic culture, whereas Japan has a collectivistic culture. The index is calculated from four questions in our questionnaire where the participants were asked to rate the importance of the described feature for an ideal job (1=of utmost importance; 5=of very little or no importance) : (1) sufficient time for your personal or family life; (2) good physical working conditions (good ventilation and lighting, adequate work space, etc.) (3) security of employment; (4) an element of variety and adventure in the job.

- Uncertainty Avoidance (UAI): A high score of UAI indicates that a society is afraid of uncertain, unknown and unstructured situations. It is derived from four questions. The first question is "How often do you feel nervous or tense at work (1=never; 5=always)?" The rest of the questions asked the participants to what extent they agree with each of the following statements (1=strongly agree; 5=strongly disagree): (1) One can be a good manager without having precise answers to most questions that subordinates may raise about their work; (2) Competition between employees usually does more harm than good; (3) A company's or organization's rules should not be broken – not even when the employee thinks it is in the company's best interest.

- Long Term Orientation (LTO): When using a Chinese Value Survey in East Asia, Hofstede (1991) identified a fifth dimension "long-term-orientation," or Confucian Dynamism, which captures the society's time horizon. It reflects to what extent a society has "a dynamic,

future-oriented mentality." A higher score implies that the past is valued less than the future, and people may look more forward. We measure this by asking participants to rate the importance of the following questions: (1) "In your private life, how important is 'respect to tradition' for you (1=of utmost importance; 5=of no importance)?" (2) "How important is 'thrift' for you (1=of utmost importance; 5=of no importance)?"

There are alternative measures for culture, most notably the Schwartz dimensions (Schwartz, 2004). They are found to be correlated with Hofstede dimensions and in order not to stretch the attention of the participants too much we did not include more than one scale into our questionnaire. Therefore, we focus on the effects of the Hofstede cultural dimensions which we measured directly in our survey.

3.3 The survey instrument

A total of 6912 university students in 53 countries/regions participated in our survey. Most participants were first or second year students from departments of economics, finance and business administration. The average age of participants was 21.5 years (SD=3.77), and 52.5% of the participants were males.

Each participant was asked to fill in a questionnaire that included 14 decision making questions (three time preference questions, one ambiguity aversion question, and 10 lottery questions), 19 questions from the Hofstede VSM94 questionnaire, a happiness question, as well as some information about their personal background, nationality and cultural origin. The questionnaire was translated into local languages for each country by professional translators or translators with economic background. The participants were

instructed that there were no incorrect answers to these questions, and that the researchers were only interested in their personal preferences and attitudes. They were also instructed that they should answer the questions independently without discussions with others.[3] In most cases, the survey was conducted during the first fifteen to twenty minutes of a regular lecture under the monitoring of the local lecturers and experimenters. The response rate was therefore very high (nearly 100%) and the number of missing items relatively small.

After excluding missing responses, the survey yielded 6901 responses for the first time discounting question, 6608 for the second question, and 6515 for the third question.

3.4 Control variables

Wealth

Inspired by several studies we decided to include the following control variables.

Becker and Mulligan (1997) proposed a model to capture endogenous time preferences. It states that the more resources we use to imagine the future, the more patient we are. It follows that wealth and education leads to patience. Most studies find wealthier people are more patient (Hausman, 1979; Lawrance, 1991; Harrison, Lau, & Williams, 2002; Yesuf & Bluffstone, 2008). Poor farm households, for example, tend to have shorter planning horizons and hence are reluctant to invest in conservation for natural resources (Mink, 1993). But there are also several studies that find no relation between wealth and discount rates (Kirby et al., 2002; Anderson, Dietz, Gordon, & Klawitter, 2004). Since we do not have individual wealth or income information,

[3]The English version of the instruction sheet is available on request.

we use GDP per capita as a proxy for wealth.

Age and gender

A number of experimental and survey studies find that time preferences are correlated with personal characteristics such as gender (Silverman, 2003) and age (Green, Fry, & Myerson, 1994). We therefore control for these variables.

Economic growth and inflation

We include the logarithm of the economic growth rate and the annual inflation rate in year 2007, the year before our survey, into the regression analysis. Since previous times of higher inflation might lead to uncertainty about the future inflation rate, we repeated all regressions with the log of the maximum annually inflation rate of the previous ten years, and no significant difference was found.

4 Results

4.1 Waiting tendency

4.1.1 Descriptive results on waiting tendency

In this section, we evaluate the results from the "wait-or-not" question ($3400 this month or $3800 next month). Table 2 shows the percentage of the participants in each country who chose to wait for $3800 next month. We observe a wide range of variation on the country level – the percentage of students who chose to wait ranged from only 8% in Nigeria to 89% of Germany. Note that the implicit interest rate in this question is as high as 11.8% per month (i.e., an annual discount rate of 280%), which is far higher than the market interest rates and inflation rates in any of these countries at the time of the survey. Therefore, the large variation across countries is hard to be justified

Table 1: Overview of countries in the sample

Country	N	Country	N	Country	N
Angola	57	Germany	540	Norway	192
Argentina	58	Greece	58	Poland	270
Australia	151	Hong Kong	101	Portugal	137
Austria	150	Hungary	262	Romania	339
Azerbaijan	122	India	61	Russia	162
Belgium	46	Ireland	194	Slovenia	96
Bosnia &Herz.	74	Israel	127	South Korea	105
Canada	84	Italy	81	Spain	45
Chile	100	Japan	274	Sweden	65
China	256	Lebanon	101	Switzerland	483
Colombia	147	Lithuania	105	Taiwan	100
Croatia	115	Luxembourg	44	Tanzania	60
Czech Rep	49	Malaysia	99	Thailand	44
Denmark	73	Mexico	89	Turkey	133
Estonia	126	Moldova	100	UK	62
Finland	124	Netherlands	88	USA	72
France	138	New Zealand	91	Vietnam	131
Georgia	38	Nigeria	93	**Total**	**6912**

purely by the differences in market interest rates or inflation rates.

In particular, 68% of our U.S. sample chose to wait (N=72). For comparison, in the survey by Frederick (2005) where he used the same question with a relatively large sample (N=807) of U.S. undergraduate students from several universities, only around 41% of the students chose to wait. Among those students who scored high in a separate Cognitive Reflection Test (CRT), there were 60% choosing the "wait" option, which is closer to our result. The potential reason is that our participants were studying economics, and thus

Table 2: Percentage of participants choosing the "wait" option

Country	Choose to wait	Country	Choose to wait	Country	Choose to wait
Germany	.89	Lebanon	.71	Romania	.57
Belgium	.87	UK	.71	Luxembourg	.55
Switzerland	.87	Slovenia	.71	Moldova	.54
Netherlands	.85	Ireland	.69	Angola	.53
Norway	.85	Taiwan	.69	Vietnam	.52
Finland	.85	USA	.68	Australia	.51
Sweden	.84	France	.65	Azerbaijan	.48
Denmark	.84	Turkey	.64	Spain	.47
Czech Rep	.80	Argentina	.64	Greece	.47
Hong Kong	.79	China	.62	New Zealand	.45
Canada	.79	Colombia	.62	Italy	.44
Poland	.78	Malaysia	.62	Bosnia.Her	.39
Austria	.78	Portugal	.60	Russia	.39
Israel	.78	Lithuania	.60	Chile	.37
Estonia	.78	India	.59	Georgia	.26
Hungary	.77	Mexico	.58	Tanzania	.23
Japan	.74	Croatia	.58	Nigeria	.08
South Korea	.72	Thailand	.57		

more likely to take the market interest rate into account. On the other hand, even 68% of the U.S. sample is still significantly lower than the percentage in Germanic/Nordic countries like Germany (89%), Switzerland[4] (87%) or Finland (86%). This difference is hard to explain only by wealth, education and the macro-economic situations.[5]

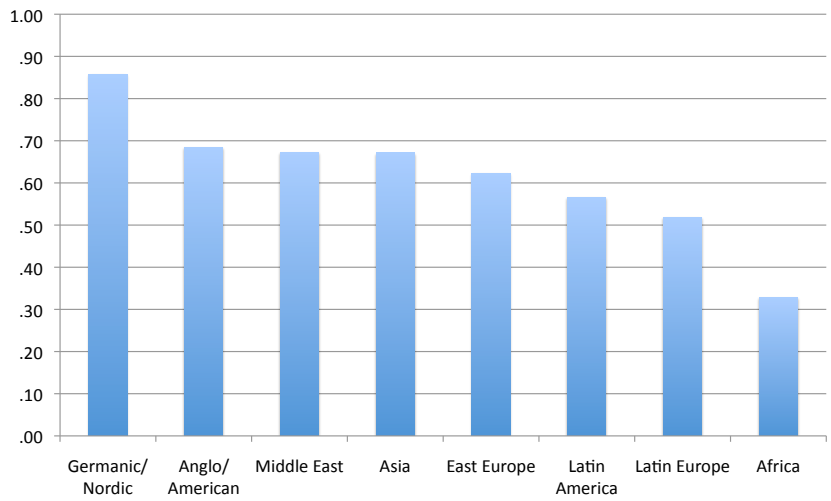


Figure 1: The percentage of choosing to wait grouped by cultural origin

Note: The column shows the percentage of participants who chose the $3800 option when they were asked to choose between $3400 this month or $3800 next month. The respondents were asked about which culture they thought they belong to. We group the countries into seven cultural clusters inspired by the classification from Chhokar, Brodbeck, and House (2008).

Each participant has stated not only their nationality, but also the culture

[4]The survey was conducted in the German language part of Switzerland.

[5]Even for the students from Princeton University, the percentage choosing the wait option is lower than the percentage among the German students (80% vs. 89%). Actually some students from our Norway survey even complained that the question was ridiculous because "*everybody* would choose to wait" for one month, given the high implicit interest rate.

they feel they belong to. We classified them into one of seven cultural clusters, mostly following the classification scheme suggested by Chhokar et al. (2008). Figure 1 shows the percentage of choosing the wait option within each cultural cluster. In general, the Germanic/Nordic group is far more likely to wait (85% chose to wait) than other cultural clusters.[6] Anglo/American, Middle East, and Asia are similar (around 66% to 68%), followed by East Europe, then Latin America and Latin Europe. Africa has the lowest percentage of participants choosing to wait (33%). In the next section, we evaluate to what extent these differences are related to cultural factors.

4.1.2 Regression results on waiting tendency

We have demonstrated that the responses to such a simple "wait-or-not" question are highly heterogeneous across countries and across cultural clusters. In the next step, we would like to explore impacts of cultural factors that correlate with the waiting tendency. To this aim, we control a number of individual and country-level variables, such as national wealth, gender, age and so forth.[7]

We employed mixed-effects multilevel regression with maximum likelihood estimates, with the consideration of interdependence among individuals within the same country. Table 3 shows the results from multilevel regressions, where the dependent variable is the answer to the waiting question with country as the group variable. In the remainder of this paper, we use mixed-effects multilevel regression for other dependent variables as well.

When looking at the impacts of demographic backgrounds, it is interesting

[6] In fact, the eight countries worldwide with the highest percentage are all from this cultural cluster – a striking result.

[7] We also repeated all regression analyses without the non-native students which did not change the results.

to notice that gender differences play an insignificant role. Although age turns out to be a significant variable, given the low variation of age among the student subjects, we consider the variable *age* only as control and refrain from making general statements.

On the macroeconomic side, coming from wealthier countries, as measured by log(GDP/capita), increases the tendency to wait, but other factors such as growth rate, inflation rate, and economic freedom seem to have little impact on the waiting tendency.[8]

Model 2 and 3 in Table 3 indicate the influence of cultural dimensions after controlling for gender, age and macro-economic variables. Individualism and long-term orientation are robust predictors of the waiting tendency, both on the country level and on the individual level. The influence of long-term orientation was as predicted. The effect of individualism is consistent with the observation by Triandis (1971) in which participants from the more individualistic culture seemed to be more "willing to defer gratification." It is also in line with the findings by Mahajna et al. (2008), where the Israeli Jews (presumably from a more individualistic culture) exhibited higher patience for monetary incentives than Israeli Arabs (presumably from a more collectivistic culture). See Section 2 for more discussion.

Model 3 includes the cultural clusters in the regression. It seems that even after controlling the Hofstede cultural dimensions, there are still significant differences across culture clusters. More specifically, participants from Germanic/Nordic, Anglo/America, Asia, and Middle East cultures are more willing to wait.

[8]Since interest rates and GDP per capita from free markets versus state-controlled markets can be defined very differently, we also repeated all regression analyses by removing countries with an economic freedom index of less than 60 (mostly unfree and repressed, according to the official characterization). The results were again basically unchanged.

Table 3: Multilevel Regression on Waiting Tendency

	standardized coefficients (t-value)		
Independent variables	Model 1	Model 2	Model 3
age	-0.005***	-0.005***	-0.005***
	(-2.70)	(-3.01)	(-2.96)
gender (male=1)	-0.100	-0.014	-0.014
	(- 0.90)	(-1.25)	(-1.26)
inflation rate	-0.036	-0.003	-0.002
	(-0.48)	(-0.51)	(-0.42)
Log (growth rate)	0.028	0.051	0.011
	(0.69)	(1.52)	(0.37)
Log (GDP/capita)	0.083***	0.076***	0.060***
	(3.46)	(3.63)	(3.08)
Economic freedom	0.001	-0.001	-0.003
	(0.24)	(-0.24)	(-1.45)
Native student dummy	0.055***	0.053***	0.017
	(2.86)	(2.67)	(0.79)
Economic major dummy	0.020	0.012	0.009
	(1.07)	(0.61)	(0.46)
IDV average		0.005***	0.003***
		(3.58)	(2.65)
IDV ind. diff.		0.000***	0.000***
		(2.65)	(2.65)
UAI average		-0.001	-0.000
		(-1.14)	(-0.04)
UAI ind. diff.		-0.000	-0.000
		(-1.03)	(-0.98)
LTO average		0.004*	0.007***
		(1.90)	(3.26)
LTO ind. diff.		0.001***	0.001***
		(4.48)	(4.53)
Africa			-0.090
			(-1.41)
Anglo/America			0.160***
			(3.48)
Germ./Nordic			0.172***
			(4.12)
L.America			0.019
			(0.30)
L.Europe			-0.046
			(-0.83)
E.Europe			0.025
			(0.60)
Asia			0.130***
			(3.09)
Middle East			0.119**
			(2.38)
N	6620	6194	6194
Deviance (-2 log likelihood)	7944.7	7387.4	7347.8
Deviance difference (chi-sqr)	50.73***	120.75***	199.27***

Note: 1.* significant at 10% level; **significant at 5% level; ***significant at 1% level; t-values in brackets

2. We denote the country average score of Individualism, Uncertainty Avoidance Index, and Long-term Orientation by "IDV average," "UAI average," and "LTO average." We denote the difference of individual scores with the country average score of the respective cultural dimension by "IDV ind. diff.," "UAI ind. diff.," and "LTO ind. diff."

4.2 Inferred Discount Rate: The Classical Approach

To infer discount rates from intertemporal decisions, we use the relationship between the present value of a cashflow, denoted by P, and its future value, denoted by F. Formally,

$$F = P(1 + R)^t,$$

where R is the discount rate and t is the time to be waited. Since both P and t are given in our questions, the inferred discount rate can be obtained easily from

$$R = (F/P)^{(1/t)} - 1.$$

We have two questions (see Section 3.1) to infer the subjective discount rate (assuming annual compounding), where t equals to 1 year and 10 years, respectively.

The classical approach states that there is only one "market riskless discount rate", which is supposed to be the same for all individuals. Our results indicate that this is not the case. Figure 2 shows the median implicit annual interest rate for one-year and 10-year matching questions for all countries.[9] We observe substantial heterogeneity of the implicit interest rate across individuals and across countries. The median implicit annual interest rate for the one year question (R_{1year}) is 100%, ranging from 14% in Australia to 1567% in Bosnia & Herzegovina, whereas the median implicit annual interest rate for the ten year question (R_{10year}) is 29%, ranging from 7% in Thailand and Spain to 73% in Bosnia & Herzegovina.

[9] We exclude Georgia from this analysis: Georgia had an extremely high implicit interest rate, especially for the one-year-matching question (14900% for the one-year question, and 86% for the ten-year question). The potential reason is that the survey in Georgia has been conducted two months before the outbreak of the Russian-Georgian war in 2008. The feeling of uncertainty induced by the tensions preluding the war may have induced high discounts for the near future.

For all countries except for Australia, the median R_{1year} is higher than R_{10year}, which is consistent with the typical empirical findings that discount rates decrease with longer time horizons. This is also true at the individual level. In total, 87% participants had an implicit interest rate R_{1year} higher than R_{10year}. A paired t-test shows that, for all countries except for Finland and India, the average implicit interest rate for one year is significantly higher than the implicit interest rate for ten years at 5% level.

The classical discounted utility model assumes consistent time preferences by using an exponential discounting model. It implies that the time preference between any adjacent periods should hold constant. Consistent with previous empirical findings (Thaler, 1981; Benzion, Rapoport, & Yagil, 1989; Du et al., 2002; Frederick et al., 2002), our results show that most people in most countries discount the near future more than the far future. This pattern can be elegantly modelled by the (quasi-)hyperbolic and subadditive discounting models, which we discuss in more details in the following sections.

4.3 Quasi-hyperbolic and subadditive discounting model

Quasi-hyperbolic discounting model

The quasi-hyperbolic discounting model is usually defined in discrete time periods as follows:

$$u(x_0, x_1, ..., x_T) = u(x_0) + \sum_{t=1}^{T} \beta\delta^t u(x_t).$$

This discount function has been used by Phelps and Pollak (1968) to study intergenerational discounting and by Laibson (1997) to intra-personal decision problems. When $0 < \beta < 1$ and $0 < \delta < 1$, people appear to be more patient in the long run and less patient for the immediate future. The

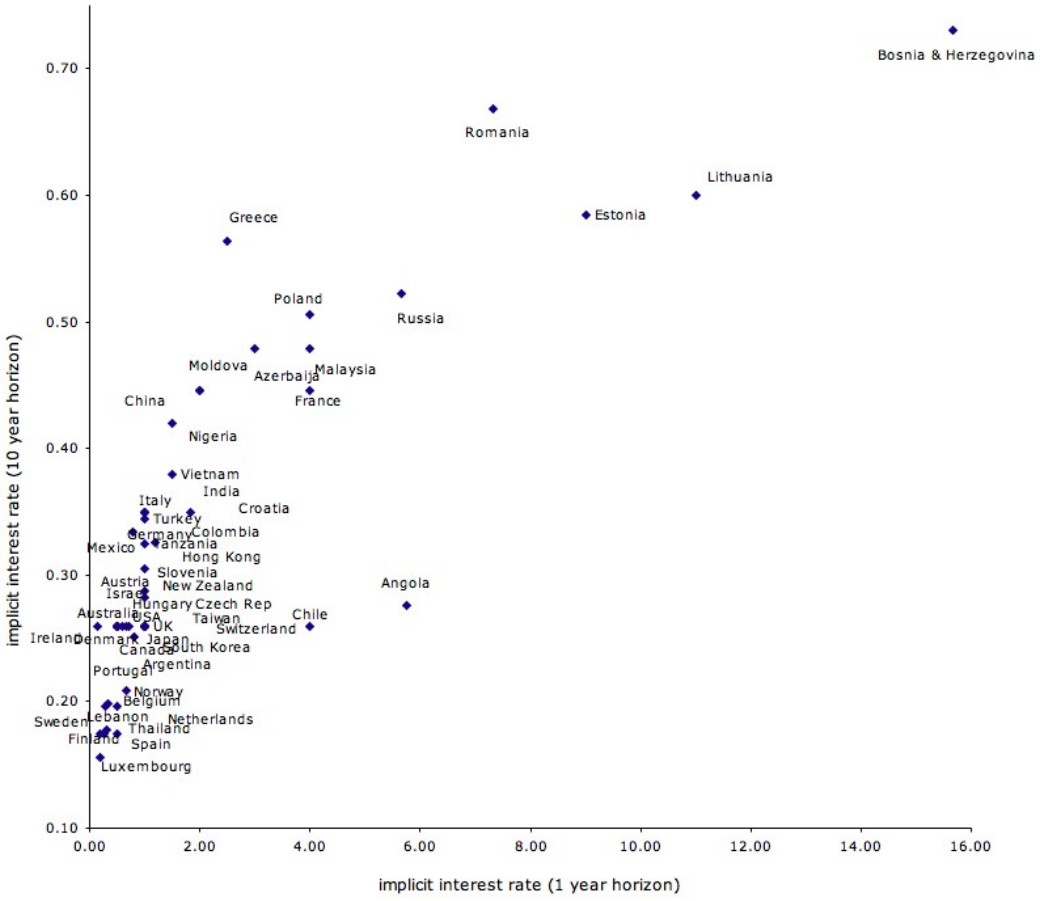


Figure 2: Median Implicit annual interest rate for 1-year and 10-year horizon

per-period discount rate between now and the next period is $(1 - \beta\delta)/\beta\delta$ and the per-period discount rate between any two future periods is $(1-\delta)/\delta$, which is less than $(1 - \beta\delta)/\beta\delta$. The quasi-hyperbolic discounting model assumes a declining discount rate between this period and the next, but a constant discount rate thereafter. It has often been discussed in the context of irrationality, such as lack of control, and thus used to justify the need for commitment devices. In particular, β refers to the degree of "present bias". Larger β implies less present bias. When β=1, the quasi-hyperbolic discount-

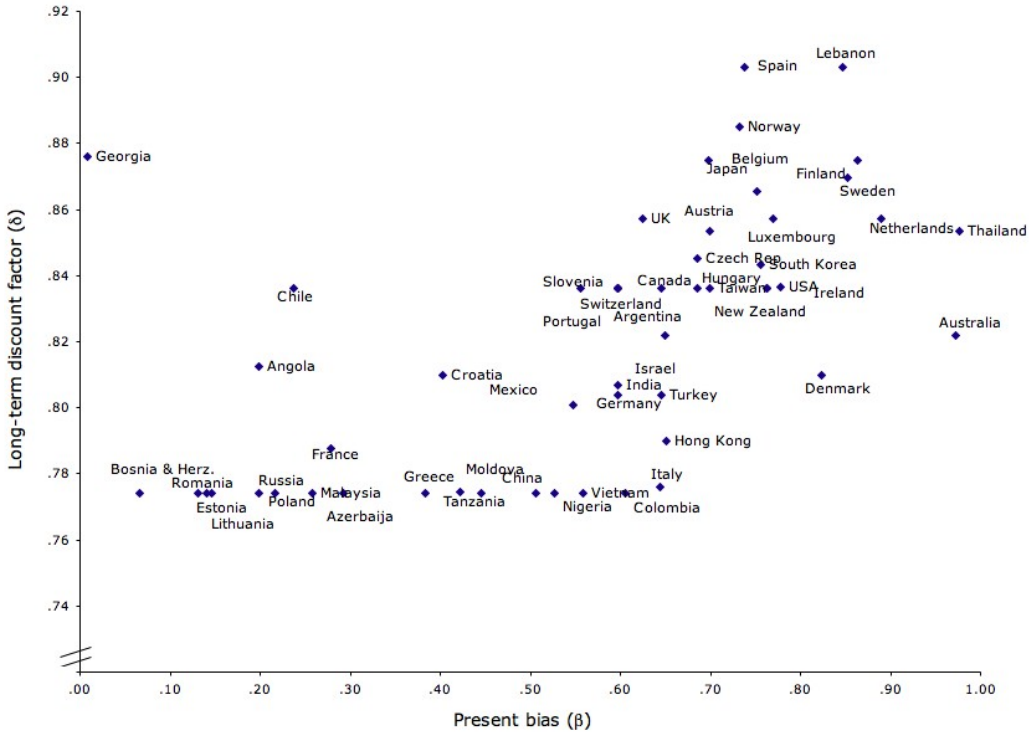


Figure 3: Median values of Parameters in Hyperbolic Discounting Model for All Countries

ing model coincides with the standard exponential discounting model. We call the other parameter δ the long-term discount factor.

When we assume a linear utility function, the two matching questions about time discounting can be represented as:

$$100 = \beta\delta F_{1year},$$
$$100 = \beta\delta^{10} F_{10year}.$$

Thus δ and β can be inferred from the responses F_{1year} and F_{10year}:

$$\delta = \left(\frac{F_{1year}}{F_{10year}}\right)^{1/9},$$
$$\beta = \frac{100}{\delta F_{1year}}.$$

For all participants, the median value of β is 0.60 (Mean=0.56, SD=0.36), and the median value of δ is 0.82 (Mean=0.82, SD=0.12). To reduce the influence from outlier responses, we have excluded a small number of participants from the analysis, since their β or δ was large (11 participants with $\beta > 2$ and 15 participants with $\delta > 2$), probably by mistake. See Figure 3 for a plot of parameter estimates of β and δ for each country. Note that the variation in the present bias discount factor β is much higher than the variation in the long-term discount factor δ.

Subadditive discounting model

Declining patience can also be explained by subadditive time discounting, i.e., people discount more when the delay is divided into shorter subintervals than when it is undivided (Read, 2001; Read & Roelofsma, 2003; Scholten & Read, 2010, 2006). Hyperbolic discounting mainly reflects impulsiveness, whereas subadditive discounting mainly reflects perception of time (Zauberman, Kim, Malkoc, & Bettman, 2009; Read, 2001; Scholten & Read, 2006). It would imply, in the context of our questions in the survey, that one year is discounted more than ten years simply because it is a shorter interval, but not because it is more present. This suggests that time discounting is not only a function of how far away the outcome is from now, but also a function of the length of the time interval.

Read (2001) suggests the following subadditive discounting function:

$$f_{T' \to T} = \frac{1}{1 + k(T - T')^s}$$

where $f_{T' \to T}$ represents the discount factor from time T' to T, k is the hyperbolic discounting factor, and s is a parameter that captures the perception of time.

Again, assuming a linear utility function, the two matching questions about time discounting can be represented as

$$100 = \frac{F_{1year}}{1 + k \cdot 1^s}, \; 100 = \frac{F_{10year}}{1 + k \cdot 10^s}.$$

Thus k and s can be inferred from the responses F_{1year} and F_{10year}:

$$k = \frac{F_{1year}}{100} - 1,$$
$$s = [log_{10}(log_{(1+k)}(F_{10year}/F_{1year})] + 1.$$

4.4 Regression results on quasi-hyperbolic and subadditive discounting factors

Quasi-hyperbolic discounting model

Table 4 and 5 show the results from regression analyses, where the dependent variables are the quasi-hyperbolic time discounting factors β and δ, respectively. Similar to previous regression results in Table 3, no significant gender differences are found. Although age is again significant, we don't make general conclusions due to the low variation in our sample. GDP per capita is also a robust predictor and participants from wealthier countries tend to discount less (higher β and δ) and thus tend to be more patient, consistent with the pattern for the waiting tendency question in Table 3. Growth rate, inflation rate, and economic freedom seem to have no significant effects, similar to the findings in Table 3.

Let us now take a look at the cultural variables: for β, we find a strong effect of Uncertainty Avoidance at both country and individual level (Table 4): individuals coming from countries with a high level of UAI and with higher than country-average UAI tend to have higher present bias. Table 4 also shows that individuals with Long Term Orientation higher than their country averages are less likely to have present bias, i.e., higher values of β.

Table 4: Multilevel Regression on Present Bias Discount Factor β

	standardized coefficients (t-value)		
Independent variables	Model 1	Model 2	Model 3
age	0.013***	0.013***	0.166***
	(7.46)	(7.13)	(7.08)
gender (male=1)	0.013	0.016	0.015
	(1.17)	(1.40)	(1.33)
inflation rate	-0.000	-0.000	0.003
	(-0.01)	(-0.03)	(0.27)
Log (growth rate)	-0.115	-0.935	-0.122*
	(-1.39)	(-1.25)	(-1.71)
Log (GDP/capita)	0.112**	0.110**	0.119***
	(2.36)	(2.46)	(2.72)
Economic freedom	-0.004	-0.007	-0.009*
	(-0.70)	(-1.42)	(-1.94)
Native student dummy	0.017	0.007	0.008
	(0.84)	(0.32)	(0.36)
Economic major dummy	0.051***	0.432**	0.043**
	(2.61)	(2.15)	(2.16)
IDV average		0.000	0.001
		(0.16)	(0.19)
IDV ind. diff.		0.000	0.000
		(0.15)	(0.17)
UAI average		-0.007***	-0.006**
		(-2.70)	(-2.32)
UAI ind. diff.		-0.000**	-0.000**
		(-2.45)	(-2.44)
LTO average		0.003	0.004
		(0.70)	(0.89)
LTO ind. diff.		0.001***	0.001***
		(2.74)	(2.76)
Africa			-0.821
			(-0.96)
Anglo/America			0.017
			(0.34)
Germanic			-0.008
			(-0.18)
L.America			-0.006
			(-0.07)
L.Europe			-0.104
			(-1.56)
E.Europe			-0.101**
			(-2.06)
Asia			0.048
			(0.93)
Middle East			-0.021
			(-0.32)
Number of Obs	6192	5833	5833
Deviance (-2 log likelihood)	7213.5	6744.4	6735.0
Deviance difference (chi-sqr)	82.90***	107.65***	122.97***

Note: 1. Larger values imply more patience.

2. * significant at 10% level; **significant at 5% level; ***significant at 1% level; t-values in brackets

3. We denote the country average score of Individualism, Uncertainty Avoidance Index, and Long-term Orientation by "IDV average," "UAI average," and "LTO average." We denote the difference of individual scores with the country average score of the respective cultural dimension by "IDV ind. diff.," "UAI ind. diff.," and "LTO ind. diff."

Table 5: Multilevel Regression on Long-term Discount Factor δ

	standardized coefficients (t-value)		
Independent variables	Model 1	Model 2	Model 3
age	0.002***	0.002***	0.003***
	(3.80)	(4.19)	(4.24)
gender (male=1)	-0.001	0.001	0.001
	(-0.35)	(0.26)	(0.23)
inflation rate	-0.001	-0.001	-0.000
	(-0.59)	(-0.48)	(-0.22)
Log (growth rate)	0.003	-0.000	0.001
	(0.31)	(-0.01)	(0.15)
Log (GDP/capita)	0.009*	0.013***	0.014**
	(1.77)	(2.64)	(2.59)
Economic freedom	0.001	0.000	0.000
	(0.91)	(0.13)	(0.07)
Native student dummy	-0.001	-0.001	-0.000
	(-0.15)	(-0.21)	(-0.04)
Economic major dummy	0.004	0.004	0.004
	(0.80)	(0.79)	(0.81)
IDV average		-0.000	-0.000
		(-1.36)	(-1.03)
IDV ind. diff.		0.000	0.000
		(0.92)	(0.91)
UAI average		-0.000	-0.000
		(-1.06)	(-0.92)
UAI ind. diff.		0.000*	0.000
		(1.65)	(1.64)
LTO average		-0.000	-0.001
		(0.57)	(-1.15)
LTO ind. diff.		0.000	0.000
		(0.38)	(0.36)
Africa			-0.006
			(-0.34)
Anglo/America			-0.010
			(-0.78)
Germanic			-0.001
			(-0.09)
L.America			0.010
			(0.58)
L.Europe			-0.001
			(-0.05)
E.Europe			-0.002
			(-0.19)
Asia			-0.002
			(-0.16)
Middle East			-0.018
			(-1.26)
Number of Obs	6196	5837	5837
Deviance (-2 log likelihood)	9272.8	8784.0	8787.4
Deviance difference (chi-sqr)	33.23***	48.04***	50.56***

Note: 1. Larger values imply more patience.

2. * significant at 10% level; **significant at 5% level; ***significant at 1% level; t-values in brackets

3. We denote the country average score of Individualism, Uncertainty Avoidance Index, and Long-term Orientation by "IDV average," "UAI average," and "LTO average." We denote the difference of individual scores with the country average score of the respective cultural dimension by "IDV ind. diff.," "UAI ind. diff.," and "LTO ind. diff."

Table 6: Multilevel regression of hyberbolic discounting rate k

	standardized coefficients (t-value)		
Independent variables	Model 1	Model 2	Model 3
age	-0.070***	-0.069***	-0.689***
	(-10.29)	(-9.98)	(-9.95)
gender (male=1)	-0.116***	-0.121***	-0.119***
	(-2.73)	(-2.75)	(-2.71)
inflation rate	0.011	0.012	-0.003
	(0.22)	(0.27)	(-0.08)
Log (growth rate)	0.379	0.282	0.377
	(1.37)	(1.16)	(1.61)
Log (GDP/capita)	-0.360**	-0.357**	-0.370**
	(-2.25)	(-2.43)	(-2.54)
Economic freedom	0.001	0.015	0.022
	(0.08)	(0.92)	(1.36)
Native student dummy	-0.073	-0.389	-0.288
	(-0.96)	(-0.50)	(-0.33)
Economic major dummy	-0.273***	-0.259***	-0.259***
	(-3.69)	-3.39)	(-3.39)
IDV average		-0.005	-0.003
		(-0.54)	(-0.37)
IDV ind. diff.		-0.000	-0.000
		(-0.22)	(-0.22)
UAI average		0.028***	0.025***
		(3.24)	(2.92)
UAI ind. diff.		0.001**	0.001**
		(2.47)	(2.47)
LTO average		-0.007	-0.127
		(-0.47)	(-0.79)
LTO ind. diff.		-0.003***	-0.003***
		(-2.78)	(-2.78)
Africa			0.419
			(1.31)
Anglo/America			-0.104
			(-0.53)
Germanic			-0.041
			(-0.23)
L.America			0.161
			(0.47)
L.Europe			0.294
			(1.18)
E.Europe			0.234
			(1.28)
Asia			-0.261
			(-1.35)
Middle East			0.063
			(0.26)
Number of Obs	6093	5747	5747
Deviance (-2 log likelihood)	23151.3	21831.0	21822.2
Deviance difference (chi-sqr)	151.38***	186.70***	202.27***

Note: 1. Larger values imply more patience.

2. * significant at 10% level; **significant at 5% level; ***significant at 1% level; t-values in brackets

3. The dependent variable is $ln(k)$. We denote the country average score of Individualism, Uncertainty Avoidance Index, and Long-term Orientation by "IDV average," "UAI average," and "LTO average." We denote the difference of individual scores with the country average score of the respective cultural dimension by "IDV ind. diff.," "UAI ind. diff.," and "LTO ind. diff."

Table 7: Multilevel regression of subadditivity factor s

	standardized coefficients (t-value)		
Independent variables	Model 1	Model 2	Model 3
age	0.021***	-0.020***	-0.020***
	(-8.62)	(-8.27)	(-8.29)
gender (male=1)	-0.050***	-0.050***	-0.048***
	(-3.21)	(-3.08)	(-2.99)
inflation rate	-0.002	-0.001	-0.006
	(-0.23)	(-0.15)	(-0.68)
Log (growth rate)	0.084	0.070	0.078
	(1.49)	(1.38)	(1.63)
Log (GDP/capita)	-0.038	-0.032	-0.025
	(-1.12)	(-1.00)	(-0.77)
Economic freedom	-0.002	0.000	0.002
	(-0.58)	(0.05)	(0.68)
Native student dummy	-0.008	-0.014	-0.010
	(-0.29)	(-0.48)	(-0.31)
Economic major dummy	-0.076***	-0.076***	-0.078***
	(-2.75)	(-2.70)	(-2.77)
IDV average		-0.001	-0.002
		(-0.62)	(-0.95)
IDV ind. diff.		0.000	0.000
		(1.48)	(1.52)
UAI average		0.005***	0.004**
		(2.77)	(2.13)
UAI ind. diff.		0.000*	0.000*
		(1.80)	(1.81)
LTO average		-0.000	-0.003
		(-0.06)	(-0.97)
LTO ind. diff.		-0.001***	-0.001**
		(-2.62)	(-2.59)
Africa			0.166
			(1.60)
Anglo/America			-0.053
			(-0.75)
Germanic			0.030
			(0.49)
L.America			0.144
			(1.44)
L.Europe			0.044
			(0.52)
E.Europe			0.169***
			(2.70)
Asia			-0.029
			(-0.45)
Middle East			0.077
			(0.96)
Number of Obs	5446	5163	5163
Deviance (-2 log likelihood)	9171.8	8723.3	8706.8
Deviance difference (chi-sqr)	106.15***	131.58***	157.44***

Note: 1. Larger values imply more patience.

2. * significant at 10% level; **significant at 5% level; ***significant at 1% level; t-values in brackets

3. The dependent variable is $ln(k)$. We denote the country average score of Individualism, Uncertainty Avoidance Index, and Long-term Orientation by "IDV average," "UAI average," and "LTO average." We denote the difference of individual scores with the country average score of the respective cultural dimension by "IDV ind. diff.," "UAI ind. diff.," and "LTO ind. diff."

It is also interesting to see that the long-term discount factor δ in Table 5 is in general not influenced by cultural dimensions, and only affected by country wealth level (GDP/capita).

Subadditive time discounting model

Table 6 and 7 show the results from regression analyses, where the dependent variables are the hyperbolic time discount rate k and the subadditivity factor s, respectively. It seems that male and economic students tend to be more patient (lower k) but have stronger subadditivity (lower s), whereas older students tend to be more patient and have less subadditivity of time discounting. Participants from wealthier countries (i.e., higher GDP per capita) tend to discount less and have lower value of k (Table 6). However, wealth is not found significant in predicting subadditivity (Table 7). Growth rate, inflation rate, and economic freedom seem to have no significant effects, similar to previous results.

Concerning the cultural variables, we find again a strong effect of Uncertainty Avoidance both on the country and on the individual level (Table 6 and Table 7): higher UAI corresponds to higher discounting, but less subadditivity. Table 6 also shows that individuals with Long Term Orientation higher than their country averages discount less, but they may be prone to stronger subadditivity, as shown in Table 7.

4.5 Partial correlations between different measurement of time preference

As mentioned before, we are not the first to study the relationship between culture and time. There is indeed an interesting connection to previous works in social psychology: Robert Levine defined and measured a concept which he called "pace of time" in a field study across 31 countries (Levine, 1997).

This overall-pace measure is calculated out of three measures that could be obtained in most countries: walking speed, postal service speed, and clock accuracy. Interestingly, we find this measurement is highly correlated with our measured waiting tendency ($\rho = 0.44$, $p < 0.01$) (see Table 8).[10]

Table 8: Partial correlations between different measurements of time preference with log(GDP/cap) as control variable

	INTRA		Levine	Globe
	Present bias	Long term	Time	Future orientation
	β	discount δ	pace	(Societal practices)
Waiting tendency	0.23	0.03	−0.53**	0.46***
df	50	50	18	32
Present bias β		0.49***	0.01	0.29*
df		50	18	33
Long term discount δ			−0.03	0.10
df			18	33

Note:

1.* significant at 10% level; **significant at 5% level; ***significant at 1% level;

2. Waiting tendency is the percentage of participants in each country who chose to wait one month in question 1. β and δ are the median value of present bias and long-term discount factor for each country, based on the responses to Question 2 and 3. "Time pace" is measured by Levine (1997) in his field study to capture the tempo and punctuality in a country. The lower score implies faster speed and more punctuality. "Future orientation" is measured by House, Hanges, Javidan, Dorfman, and Gupta (2004), p.304. Higher scores reflect a more long-term perspective as the accepted norm for the organizations.

This can be most likely understood by considering the discounting effect for disutilities: an "impatient" person would be very "patiently" procrasti-

[10]Further regression analyses showed that the time pace measure is significant even when we control for GDP per capita.

nating some dull or annoying tasks. This attitude would then manifest itself in slow walking speed, slow and inaccurate service and the tendency to postpone tedious tasks like adjusting a watch. We did not have such disutility questions in our survey, but other surveys found a strong correlation between impatience for rewards and procrastinating behavior for disutilities (Benzion et al., 1989). The correlation of Levine's measurement from the field study and our measurement from survey questions can be considered as a valuable cross-validation of both measures.

4.6 Potential applications

In the following, we want to demonstrate the validity and potential usefulness of our data on four simple examples. Each of them could be taken as a starting point for further research, based on our survey data.

4.6.1 Innovation

As the first example for possible applications of our measurement, we investigate whether we can predict a country's innovation capability by the measured patience. Technological change and innovation are often treated as exogenous variables in economic modelling. However, Romer (1990) argues that it can be endogenously determined. He points out that an increase in patience will increase research and thus economic growth, which is consistent with the intuition that one must forego some immediate benefits to invest in research and innovation, in order to get larger rewards in the future.

We test the relationship of patience with the "innovation factor" from the Global Competitive Report 2008-2009 (Porter & Schwab, 2008). It measures the technological innovation of a country, in particular investment in research and development (R & D) in the private sector, the presence of high-quality

scientific research institutions, collaboration in research between universities and industry, and the protection of intellectual property. We find a positive correlation between the response of our "wait-or-not" question with the innovation factor at the country level. The first two models in Table 9 show that after controlling the wealth level of the country, the response to the waiting question is still highly significant in predicting the innovation factor. This result suggests that although the wealth level (and hence a general level of a country's economy) is crucial to stimulate innovation, the attitude towards future also plays an important role. For example, while 69% of Taiwanese participants prefer to wait in the one-month question, only 44% of our Italian students prefer to wait. The two countries have the same GDP per capita in 2007, but Taiwan scored much higher in the innovation factor than Italy (5.26 vs. 4.19). It is worthwhile to investigate further to what extent and under what mechanism a general attitude towards the future is related to the innovation activity.

4.6.2 Environmental protection

Studies have revealed that time preference is related to the practice of environmental preservation. For example, farmers who discount the future more strongly were less likely to use soil conservation measures (Yesuf & Bluffstone, 2008). Since the wealth level is one important determinant of time preference, one may argue that we should focus on poverty reduction to make people discount the future less. However, it is not clear to what extent time preference per se is a driving factor for a lack of environmental concern. We illustrate a regression analysis to examine the relative impacts of a country's wealth level (as measured by GDP per capita) and the average patience level (as measured by our first survey question). The dependent variable is the

Table 9: Country-level OLS Regression for Innovation, Gasoline Price, Credit Rating, and Body Mass Index

	Dependent Variable							
	Innovation Factor		Gasoline Price		Credit Rating		Body Mass Index	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(GDP/cap)	0.751***	0.512***	0.651***	0.421***	−0.643***	−0.446***	0.511***	0.726***
	(7.869)	(4.435)	(5.948)	(2.972)	(−5.872)	(−3.438)	(4.123)	(4.660)
Choosing		0.366***		0.341**		−0.328**		−0.335**
to wait		(3.170)		(2.410)		(−2.530)		(−2.151)
N	49	49	49	49	50	50	49	49
Adjusted R^2	55.4%	62.5%	41.2%	46.6%	40.1%	46.1%	24.6%	29.9%

Notes:

1.* significant at 10% level; **significant at 5% level; ***significant at 1% level; t-values in brackets

2.The dependent variable "Innovation factor" is from Global Competitive Report 2008-2009 (Porter & Schwab, 2008), pp.18. It measures the technological innovation of a country, in particular investment in research and development (R&D) in private sectors, the presence of high-quality scientific research institutions, collaboration in research between universities and industry, and the protection of intellectual property. "Gasoline price" is from Esty, Levy, Srebotnjak, and Sherbinin (2005), measured by "the ratio of gasoline price to world average." "Credit rating" is based on the long-term foreign currency credit rating for sovereign bonds as reported by Standard & Poor's, available at http://en.wikipedia.org/wiki/List_of_countries_by_credit_rating. "Body Mass Index" is a measure of relative weight based on an individual's mass and height, available at http://en.wikipedia.org/wiki/Body_mass_index#Global_statistics.

"Ratio of Gasoline Price to the World Average" from the report of Environmental Sustainability Index by Esty et al. (2005). This measure is an indicator of the degree that environmental externalities have been internalized, and hence reflects the concern on environmental sustainability. Model 3 and 4 in Table 9 demonstrate that our measured time preference has a significant impact on gasoline prices at the country level, after controling GDP per capita. Our finding is in line with the experimental study by Hardisty and Weber (2009), where they find that people discount environmental outcomes in a similar way to monetary outcomes. This would help policy makers to understand societal discount rates across countries.

4.6.3 Credit Rating

Empirical evidence shows that individual time preferences are correlated with credit card borrowing and debt maturity choice (Meier & Sprenger, 2010; Breuer et al., 2014). In a Diamond-type overlapping generations model, Buiter (1981) shows that the country with a higher discounting rate runs a current account deficit. Here we would like to see whether the country-level time preference measure correlates with the credit rating of sovereign bonds, which reflects the quality of sovereign bond, the degree of public borrowing, and the probability of defaults. Model 5 and 6 in Table 9 show that the country average response to our waiting question is significantly correlated with the credit rating of sovereign bonds at the country level, again, after controlling the GDP per capita.

4.6.4 Body Mass Index (BMI)

It is also found that time preference can predict health-related behavior such as smoking and alcohol consumption, and nutrition intake (Khwaja,

Sloan, & Salm, 2006; Chabris, Laibson, Morris, Schuldt, & Taubinsky, 2008; Weller, Cook III, Avsar, & Cox, 2008). In particular, Chabris et al. (2008) and Sutter, Kocher, Glätzle-Rützler, and Trautmann (2013) find that time preference measure elicited from choices in experiments correlates with the body-mass-index (BMI) for adults and adolescents. Consistent with their findings, the last two columns in Table 9 shows that the average weighting tendency can explain a certain degree of cross-country variation for the BMI. The countries with stronger tendency to wait tend to have a low BMI after controlling the country wealth level.

Figure 4 provides a graphical overview of the relationship between the average waiting tendency and the above four variables. The y-axis represents the residuals of dependent variables after regressing on the GDP per capita. It indicates that the waiting tendency can explain some variations of the remaining residuals that can not be explained by the GDP per capita.

4.7 Further Applications

As we mentioned in the introduction, there have already been many applications of this cross-country comparison, in the field of behavioral finance where market-level behavior might be influenced by time discounting. Other applications can be found in economic policy analysis. There are certainly more questions that could be answered with the help of this data. Here are two examples:

- Buiter (1981) presents a theoretical model using country-level time preferences to explain the capital movement between countries. The model has not been tested empirically, but now that would be possible.

- Shiller (1999) suggests intergenerational and international risk sharing

in pension system, and emphasizes that the international risk sharing is rarely discussed. Empirical evidence of the degree of time discounting across countries can be an important input for such discussions.

All of these examples show that systematic investigations and documentations of time preferences across countries will definitely deepen our understanding of the discrepancies across countries, and will also provide policy makers with useful advice for development at a global level.

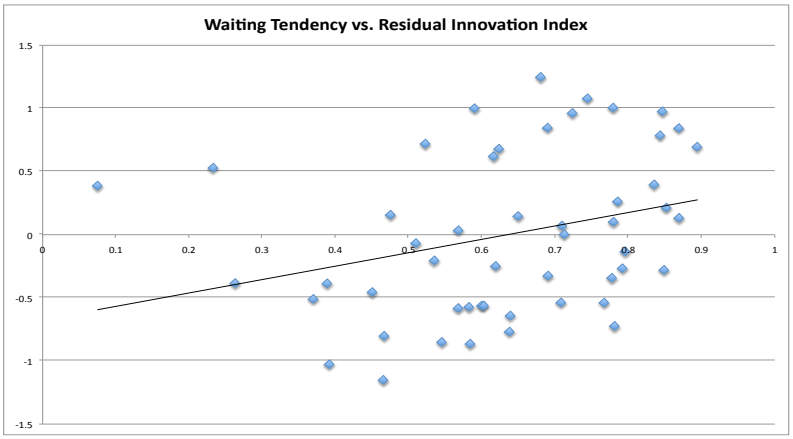
5 Discussion

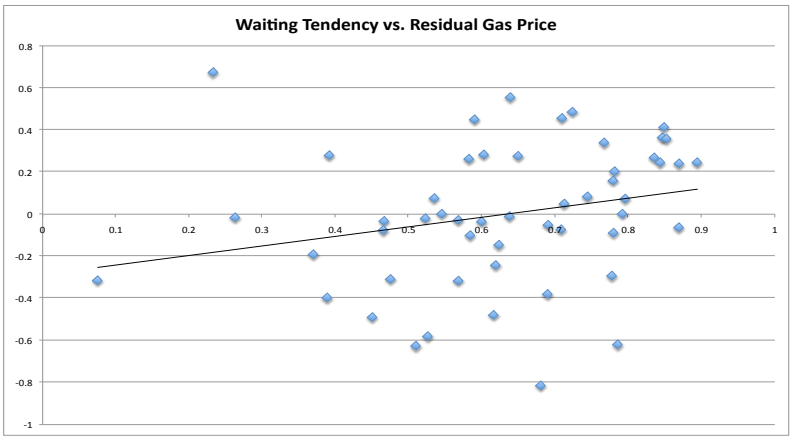
5.1 Interpretation of main results

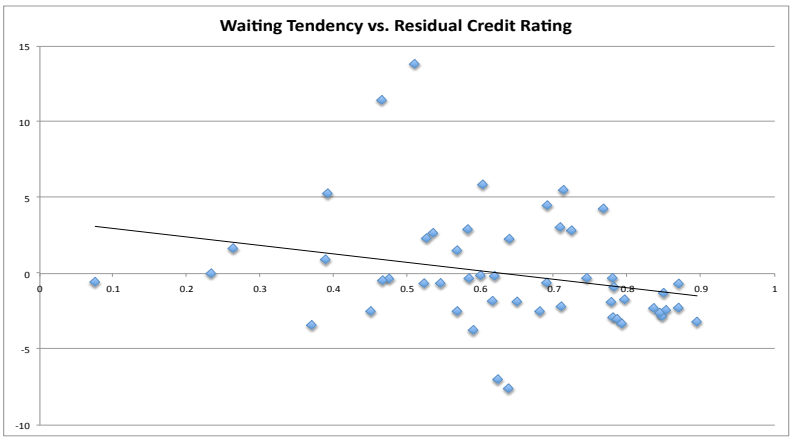
Our study provides further evidence that hyperbolic discounting is a universal phenomenon. In general, people are more patient for the distant future and less patient for the immediate future. Such time inconsistency has also been found in non-human animals (Du et al., 2002; Fehr, 2002; Green, Fisher, Perlow, & Sherman, 1981; Mazur, 1987; Rodriguez & Logue, 1988). Studies from psychological, ecological and neurological perspectives help us to understand the deeper roots of this behavioral pattern (Green & Myerson, 1996; Camerer, Loewenstein, & Prelec, 2005).

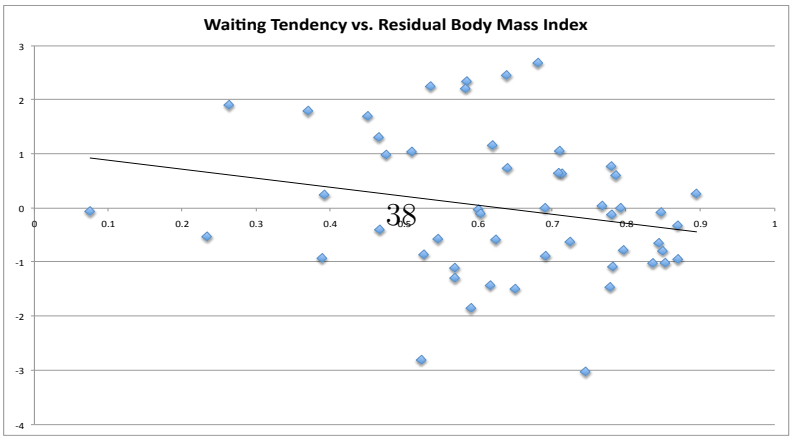
In addition to such general features of time preferences, we have also documented the systematic variation in time preferences, as compared to the situational and cultural factors of the countries. As suggested by Shefrin and Thaler (1988), intertemporal choice can be composed by two opposite processes – an affective and impulsive process versus a more patient farsighted process, which correspond to different parts of the brain, which has been observed later in various studies on brain reactions (Camerer et al.,

Figure 4: Waiting Tendency vs. Residual of Dependent Variables









2005). We have essentially three measurements in our survey, with different time horizons (one month, one year, and ten years).

The waiting question might reflect a more intuitive and impulsive decision process, whereas the long-term discount factor δ corresponds to the far-sighted decision process. The present bias factor β based on a short-term question with a one-year time horizon lies somewhere in the middle of the spectrum. Consequently, we find different sets of covariates for these three measures. Whether controlling for macroeconomic conditions or not, we find strong evidence for a cultural influence on time discounting in the case of the two "behavioral" measurements (waiting tendency and β). The effects, however, differ: the waiting tendency is significantly correlated with the individualism and long term orientation cultural dimensions, whereas β is more correlated with the uncertainty avoidance. It might be that the impulsive waiting tendency is more deeply rooted in the life style (individualistic vs. collectivistic) and the cultural values on the future (long term orientation). The decision involving a longer time horizon then reflects more the situational concern rather than the cultural manifestation. Uncertainty avoidance, as Hofstede (2001) suggested, is more concerned with the situation, as compared with the other two cultural dimensions, and it seems to play a more important role on the planning on intermediate terms (e.g., one year). Our results also show that when it comes to long term decisions (ten years), people seem to be implicitly more influenced by the macroeconomic condition such as GDP and growth rate, rather than the cultural factors. The long-term discount factor shows the least variation among the three measures, which is more consistent with the traditional economic model and seems to point to a more "rational" decision process.

According to Graham (1981), the concept of time value of money is rooted

in "linear-separable" views of Anglo-American cultures, who view time as a continuum stretching from past to present to future. In these cultures, time is considered to be an essential component of money (e.g., via discount rate/interest rate), a notion that we know from modern economic and finance textbooks. Other cultures, however, may have dramatically different views of time. In particular, Graham (1981) explains that Latin American cultures perceive time as a circular concept that repeats itself with a cyclical pattern. This "circular-traditional" view of time is the root of the *mañana* attitudes in Mexico and other parts of Latin America, where people's activities are much more oriented towards the present than towards the future. Therefore, immediate rewards are preferred. This may explain the low percentage of subjects who chose to wait in our Latin European and Latin American samples (Figure 1), even though Latin Europe is closer to Western Europe regarding economic conditions. Therefore we should be cautious to simply equate the unwillingness to wait for the larger payoff to a degree of impatience. As Graham (1981) points out, due to the large difference in the perception of time, in some cultures, when a person is forced to choose between immediate and future rewards, he may view this not as evaluating alternatives, because future rewards were perceived as of no real value. "He was essentially asked if he wanted something or nothing", and thus, "what one person views as a choice situation, another views as mandated action." (Graham, 1981, p.341) In the one-year and ten-year matching questions, when students were asked to state the amount of money that makes them indifferent, Latin European exhibited similar preferences as Germanic/Nordic cultures, whereas Latin Americans were slightly "less" patient. This again suggests that the one-month waiting question reflects more a general attitude, whereas the one-year and ten-year matching questions may be more treated as evaluative

questions.

Besides the cultural differences captured by the three aforementioned Hofstede dimensions, there are of course countless differences that cannot be captured that easily within a simple survey. We find strong evidence that these differences also affect time discounting in a significant way: including dummy variables with cultural clusters into the regression leads to significant coefficients, especially for the waiting question: Germanic/Nordic subjects, but also to a lesser extent Asian, Middle East and Anglo-American subjects showed *ceteris paribus* more "patience". These results suggest that beyond the cultural dimensions by Hofstede, further cultural differences are a key to the understanding of the heterogeneity in time discounting.

There are other cultural differences that may affect time discounting. Financial discounting, for instance, is found to be related to a range of psychological variables, such as conscientiousness (Daly, Delaney, & Harmon, 2009). Terracciano et al. (2005) reported that in their sample German Switzerland, Sweden, Germany, Burkina Faso, and Estonia have the highest scores on Conscientiousness, whereas Spain, Turkey, Croatia, Chile, and Indonesia have the lowest scores on Conscientiousness. This again seems to be consistent with our findings: those countries with higher Conscientiousness scores are more likely to wait for the delayed larger reward in our one-month question.

5.2 Methodological Concerns

There could be five major concerns or limitations regarding the survey method we adopted here. The first is that we only used university students as subjects, not a representative sample of the total population. There are, however, several advantages of this sample selection: (1) First and second year eco-

nomic students understand better the numeric formulations of lottery and time-preference questions than the general public, but can still answer the questions intuitively. (2) Students from economics can also be expected to play an important role in economics and financial markets in each country and in the global market. The time and risk preferences we study here are relevant for those finance-related activities. (3) Most importantly, as Hofstede (1991), a leading researcher in cross-cultural comparisons, emphasized: to make a cross-national comparison, it is crucial to recruit homogeneous, comparable groups from each country in order to control the background variables as much as possible. University students of economics can be considered as a sample satisfying these properties well.

The second concern about our survey method might be that we only elicited hypothetical questions without offering real monetary incentives, such that participants may not be motivated to give thoughtful answers. However, researchers who compared directly the real and hypothetical rewards did not find clear and systematic differences (Johnson & Bickel, 2002; Coller & Williams, 1999; Kirby & Marakovic, 1995). Moreover, hypothetical questions have even some advantages in the domain of time preferences because they allow to ask questions involving a long time span and large payoffs (Frederick et al., 2002).

A third concern is whether the sample size in each country is sufficiently large and representative. Previous research shows that even within the same country, the cultural difference can be very large, e.g., Talhelm et al. (2014). Indeed, we would have been happy to have large sample sizes in every country, but in a few countries this was infeasible. However, the total number of subjects is substantial and the large number of countries from which we collected data allows to test competing factors on the country level that a

study in fewer countries with a larger subject pool in each country could not achieve. Moreover, we have shown that the between-country variation, as compared to the within-country variation, is large enough to justify our approach.

A further concern is whether time preferences can be elicited independently from the interest rates of the markets to which the respondents have access to. One can argue that in a perfect capital market where individuals can borrow and lend freely, the personal taste concerning time preference cannot be elicited, because intertemporal choices are made such that the personal discount rate corresponds to the interest rate in the market. If markets were perfect and people answered the question relating the stated monetary amounts to the borrowing and lending opportunities in these markets then we would find the discount rates measured in our survey to equal market interest.

Many studies, however, have shown that stated discount rates tend to be much larger (compare the survey of Frederick (2005)). One of the reasons might be that in reality markets are far from perfect: even in countries with well-developed financial systems there are many constraints, particularly on borrowing money. They can be institutional or cultural in nature: in some countries, obtaining a loan might be impossible for many people (compare Beck, Demirgüç-Kunt, and Peria (2008) for an international comparison study on this issue), whereas in other countries taking a loan for consumption might be considered simply as foolish behavior that could reduce reputation substantially. Another reason might be that the respondents understood the difference between their personal time preference and the market interest rate and answered the question applying the former, i.e. without considering the borrowing and lending opportunities offered in the capital market they

have access to.

A final limitation of our study is that it only focuses on time preferences in gains, and it is not clear whether the results can be generalised to intertemporal choices involving losses. Normative economic theories prescribe people to discount both future gains and losses due to opportunity cost and uncertainty, and there should be no differences in discount rates in gains and losses. However, a general finding is that gains are discounted more than losses. This has been called the *sign effect* (Benzion et al., 1989; Thaler, 1981; Yates & Watts, 1975). More strikingly, a substantial proportion of participants even prefer a sooner loss to a later loss of the same or smaller size, showing none or even a negative discounting tendency, e.g., Hardisty and Weber (2009), Hardisty, Appelt, and Weber (2013), Loewenstein (1987), Sun et al. (2015), van der Pol and Cairns (2000).

The underlying determinants of time discounting, including neural, psychological, social and economic factors, can be very different in gains and losses, and the interaction is complicated. Xu, Liang, Wang, Li, and Jiang (2009) demonstrate that although intertemporal choices in gains and losses both activate brain regions that are related to high-level cognitive processes, discounting future losses leads to greater activation of brain regions related to negative emotions. This is in line with the finding by Hardisty and Weber (2009): higher CRT (cognitive reflection test) scores are related to less discounting in gains but have no effects in losses.

Both studies seem to imply that discounting losses is a more affective than cognitive process. Moreover, Hardisty and Weber (2009) suggest that social and cultural norms typically encourage people to wait for larger later gains, but to avoid larger later losses (patient in both gains and losses), whereas the fixed-cost present bias as documented by Benhabib, Bisin, and Schot-

ter (2010) (i.e., psychological desire to resolve events immediately) may lead people to accept both immediate gains and losses (impatient in gains but patient in losses). Therefore, we expect that cultural factors such as Long-Term Orientation should increase patience in both gains and losses (wait for later gains and avoid larger later losses), whereas factors that are more related to psychological dread such as Uncertainty Avoidance may cause people to want immediate gains and losses (i.e., decreases patience in gains but increases patience in losses). Moreover, a recent neutral study by Tanaka, Yamada, Yoneda, and Ohtake (2014) report that participants with the sign effect exhibit stronger brain activity to magnitude and delay of losses than that of gain, suggesting loss aversion as potential mechanism to sign effect. Using INTRA survey, ? (?) report the relation between culture and loss aversion, and discuss the potential role of emotional regulation. Taken together, we may also deduce that countries with stronger loss aversion also tend to exhibit stronger sign effect due to the variation of emotion regulation shaped via cultural influence. We encourage future research to establish further hypotheses and test empirically the relation of culture and time discounting in both gains and losses to help us understand the social and psychological mechanisms for time discounting.

6 Conclusion

We report an international survey on time preference across 53 countries. Our results are consistent with the previous hyperbolic discounting literature in that all countries exhibit stronger discounting for one year than for ten years. More importantly, there is a large cross-country variation in responses to time preference questions, especially to questions concerning waiting tendency and

short-term discounting rate. Several Hofstede cultural dimensions are correlated to the time preference measure. We suggest several applications by using time preference to explain cross-country difference innovation, environmental protection, credit rating, and health-related behavior as reflected in the BMI.

Several independent variables in our regression models were endogenous. Ideally, the parameters should have been estimated by using a simultaneous equation system. With our cross-section data, it is difficult to identify instrumental or lagged variables for such analysis. If time series data could be collected in the future, then one might gain more insights about causal relationships. Despite these limitations, this study sheds light on several important aspects of time preference.

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